~~S--t~~ Stuff Happens!

Real life experience of the array of issues that can impact PV asset financial performance

SPI 2014
Certification Workshop, Monday October 20 2014
John Sedgwick, President VDE Americas
Peter Bostock, Vice President, VDE Americas

- **VDE Institute**
  - 154 year old internationally recognized certification Body
- **Fraunhofer ISE**
  - "World Class" applied research
- **VDE Americas**
  - Wholly owned subsidiary of VDE Germany

30 Years
>38 GW

Effects on PV investments

- Increased uncertainty

- Higher perceived risk

- Redefinition of bankability criteria
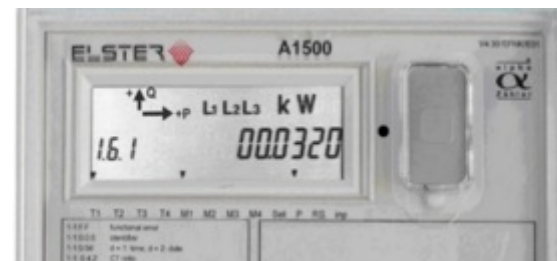
- Higher expectations on **overall system quality**

Complete system quality

System construction & execution

System planning & engineering

Components

LCOE and Performance Ratio
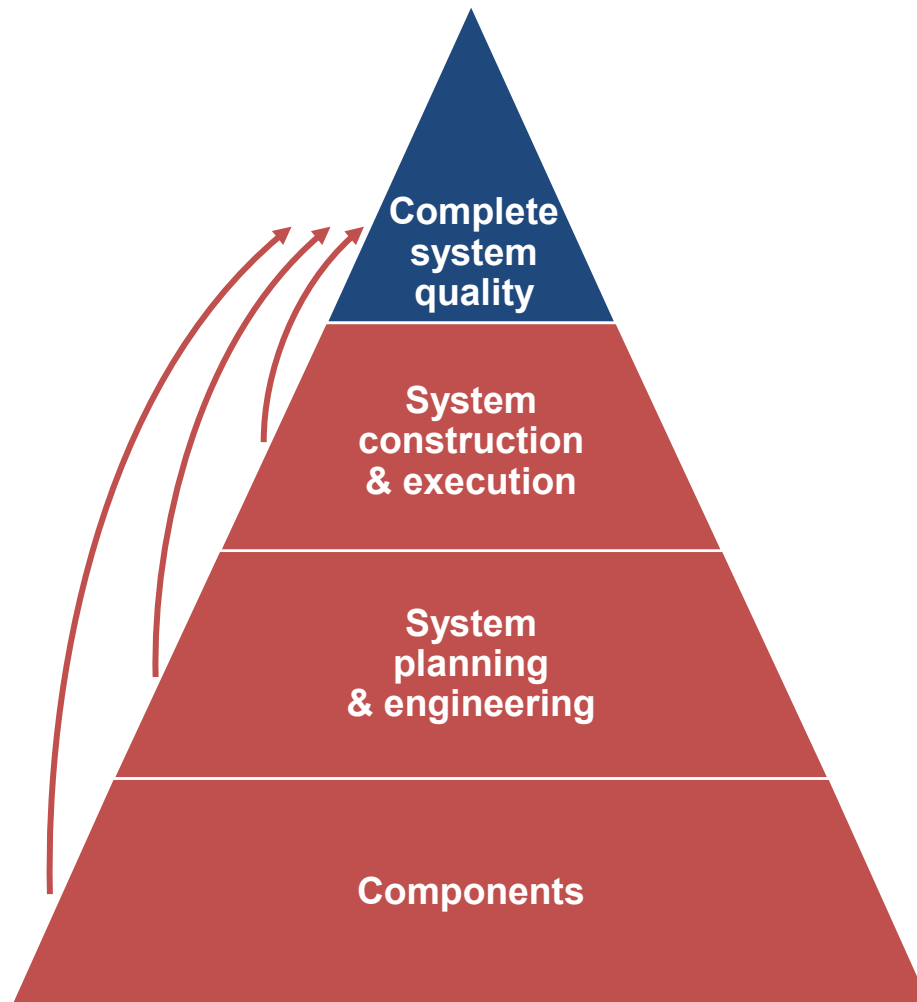
Levelized Costs of Energy

LCOE =

Performance Ratio

PR =

Quality measures for utility scale PV Plants
Input data for yield prediction and typical uncertainties

± 1.5%

±5%

± 2.0%

$

± 2.0%

± 2.0%
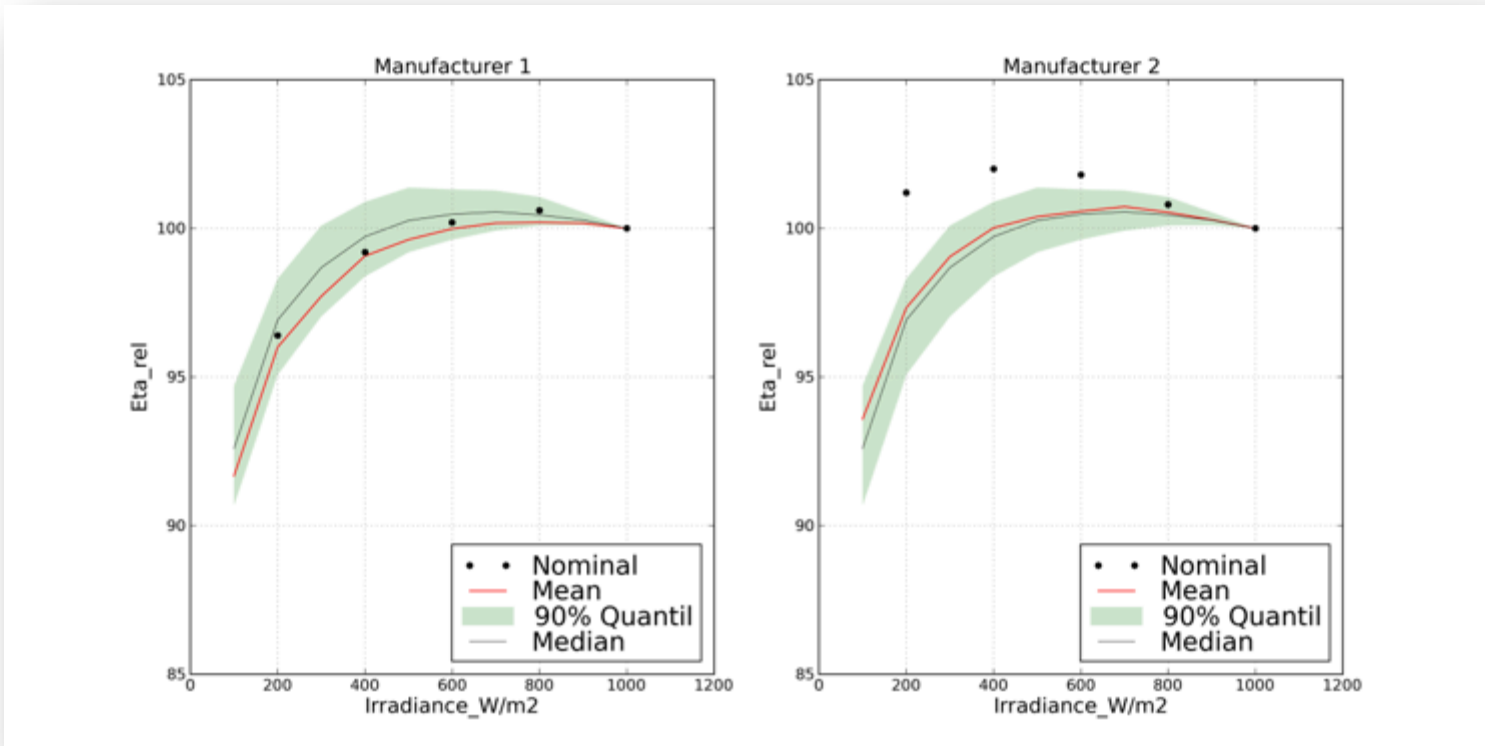
± 0.5 to 1.0%
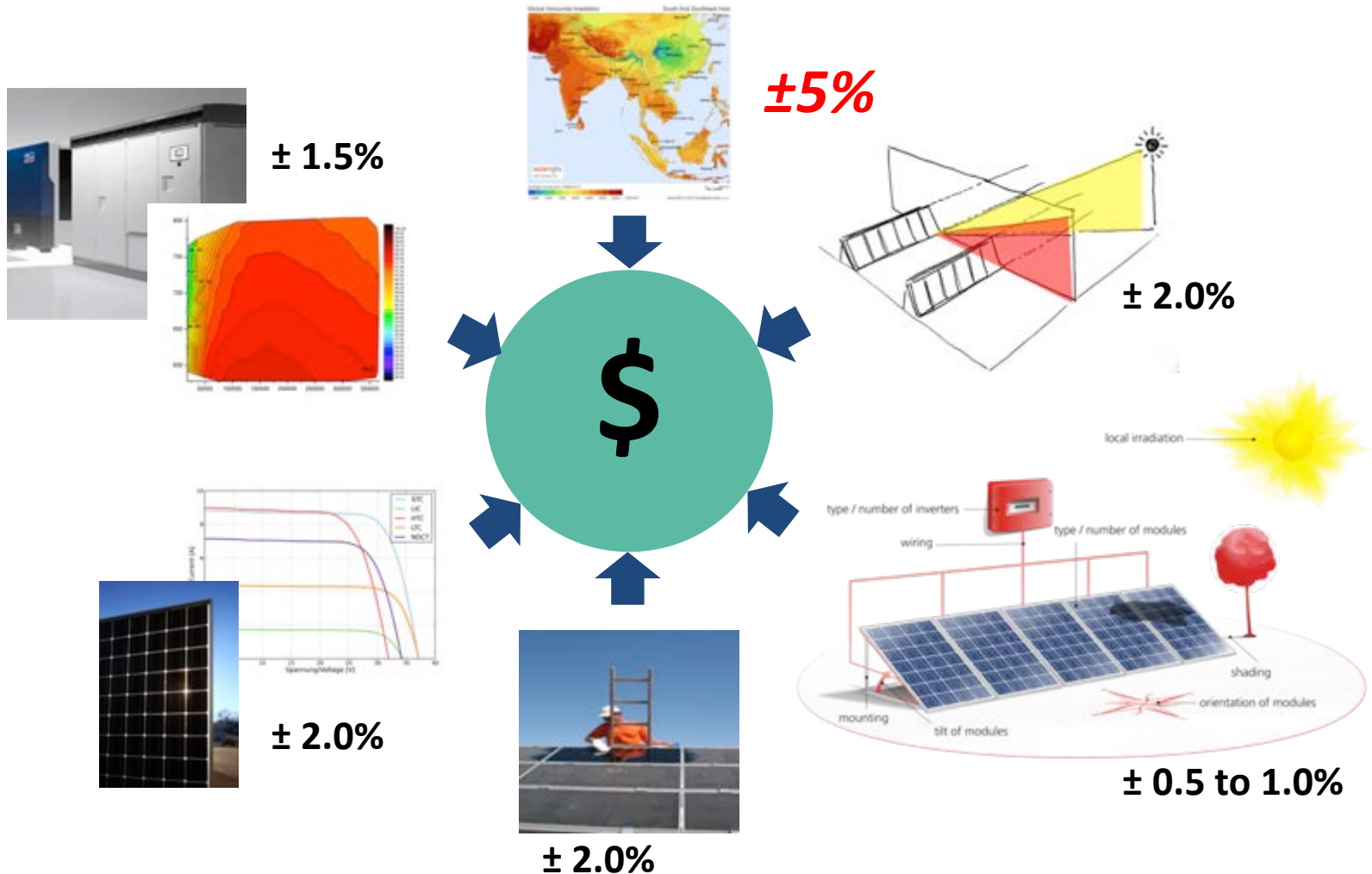
Manufacturer Data Sheets?

Fig: comparison on manufacturer and laboratory results for irradiance dependence of poly-Si modules
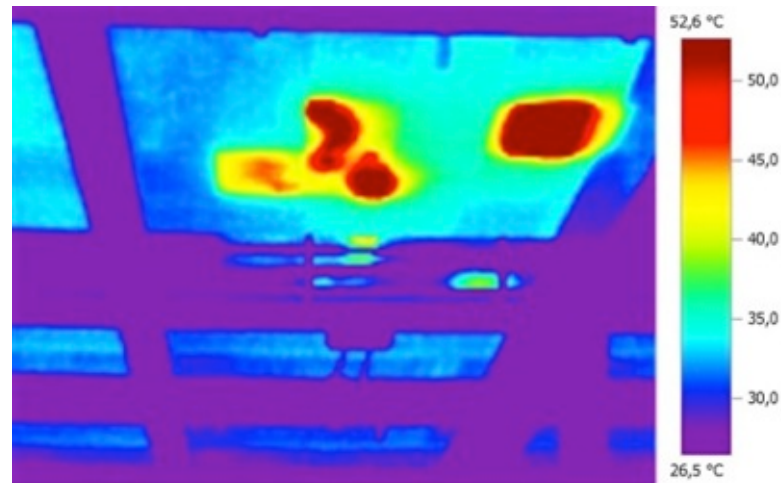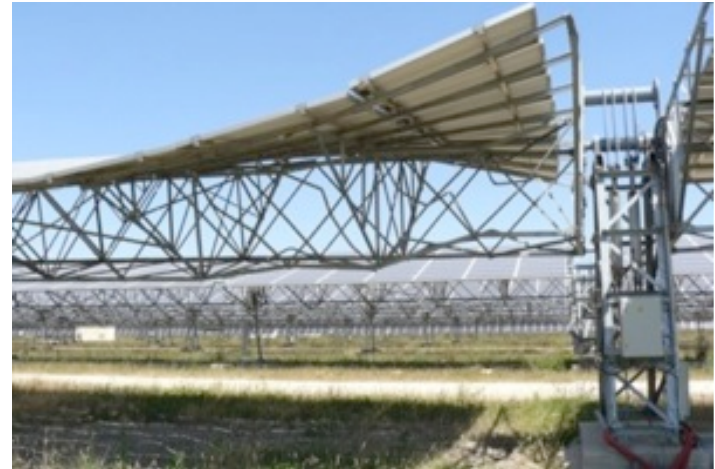
Asset Value Uncertainty
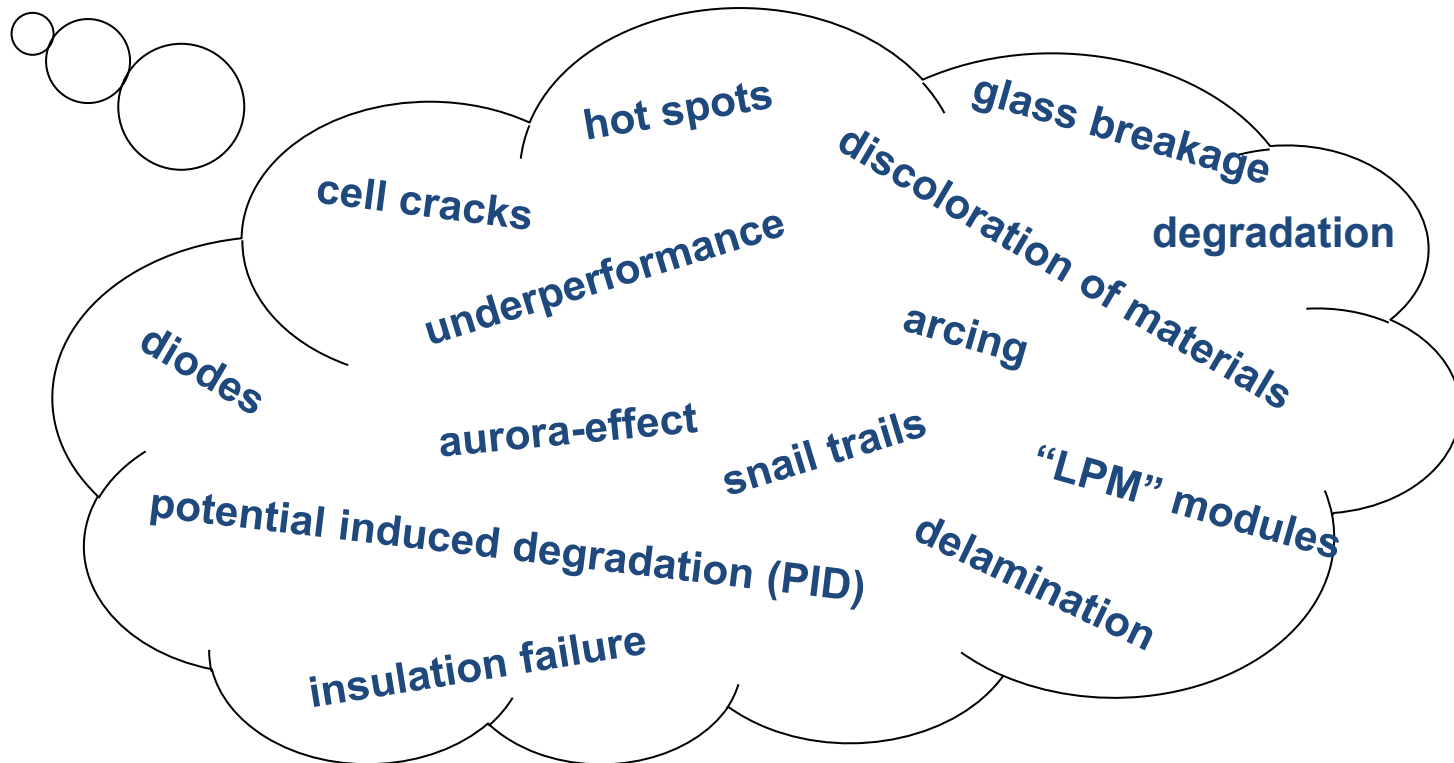
- Max $
- Minimum uncertainty

2 + 2 =??

Real Life Issues

- Design
- Implementation
- O&M

Quality measures for utility scale PV Plants
Experiences from the field

Known failure mechanisms impacting performance

hot spots

glass breakage

cell cracks

discoloration of materials

degradation

underperformance

diodes

arcing

aurora-effect

snail trails

"LPM" modules

potential induced degradation (PID)

delamination

insulation failure

Implementation

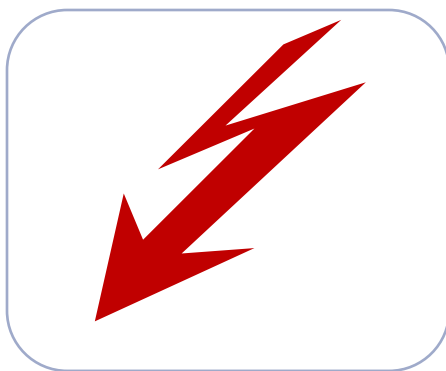Simple, but critical and the biggest offender

System Issues

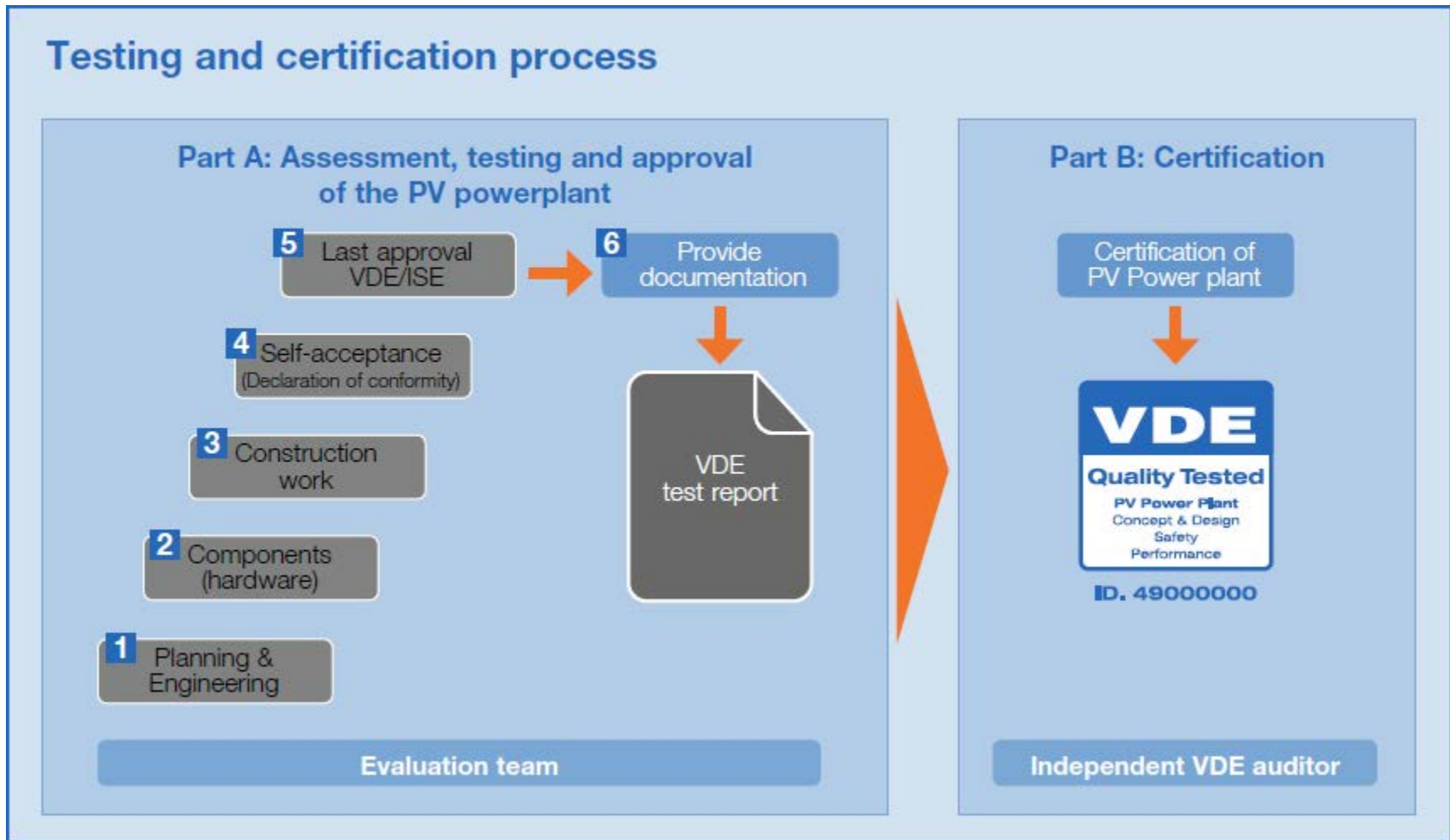- Inverter
- Fire Hazard
- Lightning
- Grounding

O&M

- Baseline Required
- Certification
  - Procedures
- Cost Effective

Quality Assurance of Large Scale PV Power Plants New Standard developed by VDE and Fraunhofer
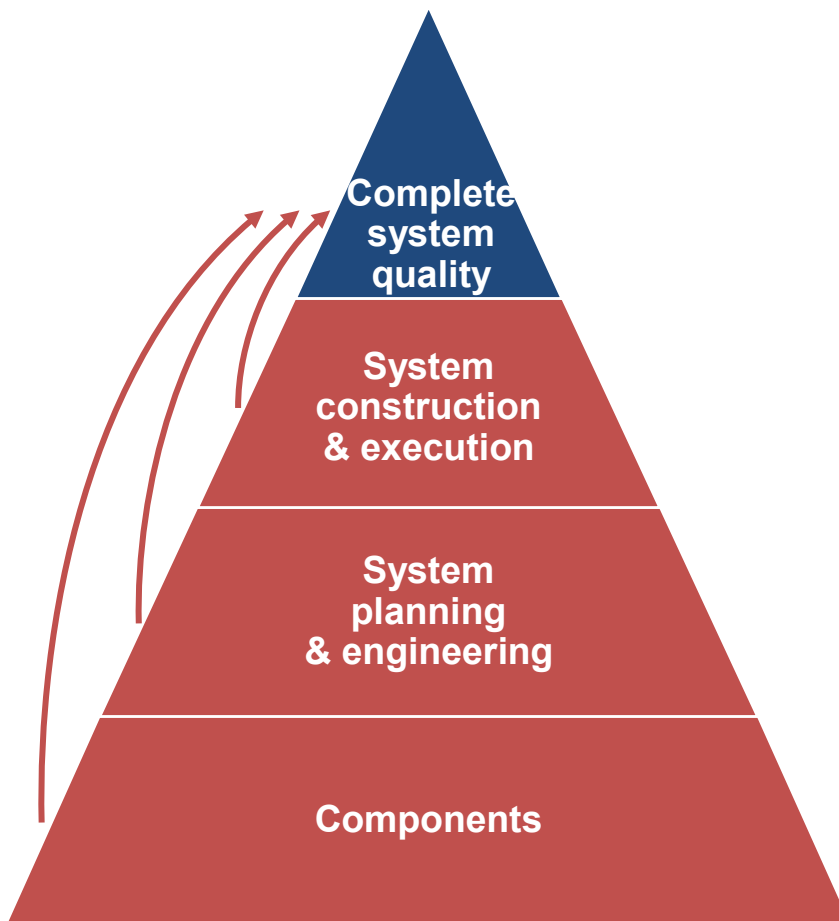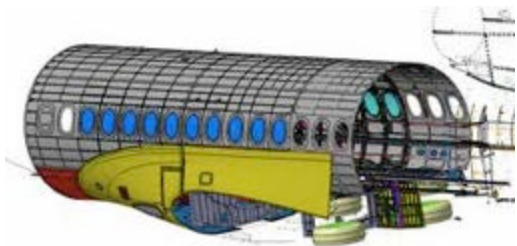

Farnung et. all: Complete PV Power Plant Certification: New Standards for Quality Assurance of Large Scale PV Power Plants, in 40th IEEE Photovoltaic Specialists Conference, Denver, Colorado, USA, 2014

Summary

System-wide certification is a required element of the maturing solar industry

Pyramid diagram (top to bottom):
- Complete system quality
- System construction & execution
- System planning & engineering
- Components